The London Resort Development Consent Order

BC080001

Environmental Statement
Volume 2: Appendices

Appendix 13.3 – Saltmarsh Survey Field Report

Document reference: 6.2.13.3
Revision: 00

December 2020

Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
Regulation 5(2)(a)
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Regulation 12(1)

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Revisions

Revision	Description	Issued by	Date	Approved by
00	Issue for DCO Submission	RA	24/12/2020	APEM/MH

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Executive Summary

BSG Ecology was commissioned by APEM Ltd to undertake a National Vegetation Classification survey of salt marsh habitat around the Swanscombe Peninsula in Kent, to provide baseline information for an assessment of the impacts of the London Resort Proposed Development.

The aim of this survey was to identify, describe and map the vegetation communities present with reference to plant communities described in the National Vegetation Classification.

Field survey was carried out on 25th and 26th August 2020. The Survey Area (see Figure 13.3.1) was walked to identify and map homogeneous stands of vegetation. Representative stands of each of the plant communities present were sampled using 2 × 2 m quadrats. Vegetation on some areas of soft mud were not safely accessible, and were therefore not surveyed directly, although such vegetation could be clearly viewed from adjacent areas.

Data analysis involved the use of community identification keys, comparison of data with published tables, and analysis using Modular Analysis of Vegetation Information System (MAVIS) software.

The survey work was carried out by Dr Tom Flynn, Principal Ecologist at BSG Ecology, with assistance in the field by Jemma Wilson, Field Scientist at APEM.

Saltmarsh vegetation is present along the majority of the section of shore that was surveyed. The presence of a sea defence embankment meant that this habitat is limited in its width. Where present, low saltmarsh (developing over deposits of soft mud or mud and pebbles) supported SM6 *Spartina anglica* saltmarsh and S21 *Scirpus maritima* swamp. The latter dominated this zone in a west-facing creek towards the centre of the Survey Area.

The mid-level of the saltmarsh was dominated by SM13 *Puccinellia maritima* saltmarsh community. In some areas, the seaward edge of this community formed a sheer face of clay and mud ca. 1 to 2 m in height. There was generally little or no saltmarsh vegetation below this face.

The upper saltmarsh was heavily dominated by S24 *Elymus pycnanthus* saltmarsh community. Low-lying areas within the upper marsh supported the SM23 *Spergularia maritima-Puccinellia distans* saltmarsh community, including within a channel behind the embankment towards the east of the Survey Area.

An attenuation basin in the west of the Survey Area supported some SM16 Festuca rubra saltmarsh community, and areas of low vegetation dominated by sea plantain. S4 *Phragmites australis* swamp was present in some parts of the Survey Area.

Of the plant communities present in the Survey Area, SM13 saltmarsh and SM23 saltmarsh are EU Annex I habitats. In addition, 'Estuaries' comprise EU Annex I habitat 1330 (Atlantic salt meadows). 'Coastal Saltmarsh' is a Habitat of Principal Importance in England under Section 41

of the NERC act; this is likely to include all vegetation seaward of the sea defence embankment in the Survey Area.

The majority of the saltmarsh in the Survey Area is considered to be in 'Fairly good' condition based on Natural England criteria, despite abundant wood and plastic rubbish being in some areas, and the presence of the embankment itself. The low lawn of sea plantain in the inland basin at to the west of the survey area, and the SM23 saltmarsh in the inland channel in the eastern section of the Survey Area are considered to be in 'Poor' condition.

The Nationally Scarce plant species golden samphire *Inula crithmoides* was occasionally present on the seaward edge of low clay cliffs that supported SM13 and SM24 saltmarsh along the eastern third of the Survey Area.

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Glossary

CEcol	Chartered Ecologist
GPS	Global Positioning System
MAVIS	Modular Analysis of Vegetation Information System
MCIEEM	Member of the Chartered Institute of Ecology and Environmental Management
NERC	Natural Environment and Rural Communities
NVC	National Vegetation Classification
SAC	Special Areas of Conservation
SSSI	Site of Special Scientific Interest

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Chapter One ◆ Introduction

1.1 BSG Ecology was commissioned to undertake a National Vegetation Classification survey of saltmarsh habitat around the Swanscombe Peninsula in Kent.

SITE DESCRIPTION

1.2 The Swanscombe Peninsula is a triangular area of land approximately 1.6 km long and 1 km wide, projecting into the Thames Estuary from its southern bank, between Gravesend and Greenhithe. See Appendix 1.0 and Figure 13.3.1, Figure **13.3.2**, Figure **13.3.3** and Figure **13.3.4** below.

1.3 Aerial photography (Google Earth, 2020) indicates that the northern half was marsh and the southern half in agricultural use in the mid-20th century, and that by the late 20th century the northern marsh had largely been reclaimed for landfill purposes. The peninsula is currently dominated by scrub and rough grassland, with a narrow fringing saltmarsh along approximately half of its shore.

1.4 Soil mapping indicates that the peninsula supports loamy and clay soils of coastal flats with naturally high groundwater (Cranfield University, 2020).

1.5 The Swanscombe Peninsula is not currently subject to any statutory nature conservation designations such as Site of Special Scientific Interest (SSSI) or Special Area of Conservation (SAC).

1.6 West Thurrock Lagoon and Marshes SSSI, which supports saltmarsh habitat, is present approximately 1 km to the west on the northern bank of the Thames Estuary.

1.7 The south-eastern part of the peninsula, known as Botany Marshes, supports grazing marsh and is managed as an RSPB reserve.

PROJECT BACKGROUND

1.8 This survey provides baseline information for an assessment of the impacts of the London Resort Proposed Development on the Swanscombe Peninsula.

AIM OF SURVEY

1.9 The aim of this survey was to identify, describe and map the vegetation communities present within saltmarsh habitats between the eastern and western limits of the Survey Area shown on Figure 13.3.1 and Figure 13.3.4, with reference to plant communities described in the National Vegetation Classification (NVC) (specifically in Rodwell *et al*., 1995 and Rodwell *et al*., 2000).

METHODS

1.10 A vegetation survey of saltmarsh habitats and other intertidal vegetation was carried out between the western and eastern survey limits, as shown on Figure 13.3.1, Figure 13.3.2, Figure 13.3.3, and Figure 13.3.4, on 25th and 26th August 2020. Survey work was carried out in the lower half of the tidal cycle to allow access to all coastal saltmarsh areas. All areas of saltmarsh vegetation within these extents are referred to as the 'Survey Area'.

1.11 On the first survey, the Survey Area was walked to identify and map homogeneous stands of vegetation. Aerial photographs from 2019 (obtained from Google Earth) were used as a base map in the field. Where they were not obvious on the aerial photograph, the boundaries of some areas of vegetation were plotted using a hand-held GPS device. Provisional identification of NVC plant communities was made on the first day; this was an initial visual assessment based on surveyor experience.

1.12 One the second day of the survey, individual stands of vegetation were examined in more detail. Representative stands of each of the plant communities present within the survey area were sampled using 2 m × 2 m quadrats marked out using a tape measure. For each quadrat, the surveyors identified all vascular plant species present and estimated their percentage cover. Quadrat locations are shown in Figure 13.3.1, Figure 13.3.2, Figure 13.3.3, and Figure 13.3.4. The results of this survey are provided in Chapter two: *Results and interpretation*

1.13 A minimum of five quadrats were sampled in the main saltmarsh communities. For communities occupying very small areas, where access was difficult due to soft ground (e.g. in the S21 swamp community), where vegetation was highly homogeneous (e.g. in the S4 reed bed, comprising only common reed *Phragmites australis*), fewer quadrats were employed. Where quadrat data was later split into separate communities or sub-communities, fewer than five per community or sub-community may have resulted.

1.14 Representative photographs of the various plant communities were taken. Photograph locations are shown in Figure 13.3.1, Figure 13.3.2, Figure 13.3.3, and Figure 13.3.4.

DATA ANALYSIS

1.15 Quadrate data for each separate community were tabulated using Microsoft Excel and formatted into a floristic table (as used in Rodwell *et al*., 2000) based on inter-quadrat frequency (i.e. constancy). Data analysis involved three methods.

- The vegetation community identification keys in Rodwell et al. (1995) and Rodwell et al. (2000) were used to identify plant communities, based on the data in the floristic tables.
- The floristic tables were compared (by inspection) with those of Rodwell et al. (1995) and Rodwell et al. (2000).
- The data were entered into the Modular Analysis of Vegetation Information System (MAVIS) software (CEH, 2016). Quadrat data from each homogenous stand of

vegetation was subject to a combined group analysis, based on inter-quadrat frequency values, to determine similarity with published NVC datasets

1.16 A written summary of each of the vegetation communities was also produced in Chapter two: *Results and interpretation*.

SCIENTIFIC NAMES

1.17 Scientific names used in this report follow Stace (2010). Plant community names follow Rodwell *et al*. (1995 and 2000). This means that plant community names use superseded scientific names in some instances. Former plant names are provided on first use where necessary.

1.18 The form of sea aster *Aster tripolium* with rayless inflorescences is sometimes referred to as a subspecies or variety (ssp. *discoides* or var. *flosculosus*), although this is not recognised in Stace (2010). This species exhibited both rayed and rayless forms within the Survey Area, and also numerous examples of intermediate forms. Because of the continuous variation present, all of these plants were recorded as *A. tripolium* in this survey.

PERSONAL

1.19 The survey work was carried out by Dr Tom Flynn, Principal Ecologist at BSG Ecology. Tom has worked a professional ecologist for over fifteen years. He is a Chartered Ecologist (CEcol) and a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM). He has a DPhil in Plant Sciences, and a Level 5 Field Identification Skills Certificate from the Botanical Society of the British Isles. Tom's specialist expertise is in habitat and botanical survey and assessment. He has carried out numerous National Vegetation Classification surveys across the UK, including survey and monitoring of Sites of Special Scientific Interest, and surveys of coastal and saltmarsh habitats.

1.20 Tom was assisted in the field by Jemma Wilson, Field Scientist at APEM.

1.21 This report was written by Dr Tom Flynn and was technically reviewed by Guy Miller, Principal Ecologist at BSG Ecology. Guy is a Chartered Ecologist (CEcol) and a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM); he has worked as a professional ecologist since 1998. His key areas of work include ecological impact assessment and habitat survey, and he has professional experience of botanical surveys of coastal sites.

LIMITATIONS

1.22 As the survey was carried out in August, it was an appropriate time of year for saltmarsh vegetation identification and survey of saltmarsh extent.

1.23 Certain areas of the upper marsh appear to have suffered from drought and supported dead vegetation at the time of the survey. This was mainly the case in the inland channel at the east of the Survey Area (see Figure 13.3.4). The dead vegetation present was

examined, and the main species present were identified, and this is therefore not considered to be a significant limitation to the survey.

1.24 The saltmarsh habitats were generally accessible on foot without any specialist equipment. However, the lower marsh around the creek towards the centre of the Survey Area was on soft mud that was not safely accessible, and these areas were therefore not directly accessed. This vegetation could be clearly viewed from adjacent higher areas allowing this vegetation to be characterised in terms of the NVC: it supports stands of sea club rush *Bolboschoenus maritimus* (formerly called *Scirpus maritimus*), interspersed with a few small areas of common cord-grass *Spartina anglica*.

1.25 MAVIS analysis seems to fail to compute correctly for stands containing a high frequency of common cord-grass *Spartina anglica*, yielding zero percentage matches. MAVIS analysis was therefore not used in the analysis of vegetation that is dominated by this species. This is not considered a significant limitation since SM6 is the only NVC community that is dominated by this species (and this has no recognised sub-communities). The interpretation, even without the use of MAVIS, for vegetation dominated by common cord-grass is therefore very clear.

Chapter Two ◆ Results and interpretation

2.1 Saltmarsh vegetation is present along the majority of the section of shore that was surveyed. The exception is a section towards the western end that has a piled dock area in deeper water, with no marsh present (see Figure 13.3.2).

2.2 Where present, the saltmarsh habitats vary from around 7 m to 70 m in width, with wider areas being present on the more sheltered western side of the peninsula and narrower sections being present on the eastern side, which has a steeper shore and faces into the lower estuary and seaward.

2.3 A coastal defence embankment runs along the entire length of the survey section. This forms a topographical upper limit to the saltmarsh habitats, with the exception of two low lying areas just inland of this structure.

2.4 The presence of the embankment means that saltmarsh is generally limited in its width, and the zonation is restricted to narrow bands. Where present, low saltmarsh developing over deposits of soft mud or mud and pebbles, supported SM6 *Spartina anglica* saltmarsh and S21 *Scirpus maritima* swamp. The latter dominated this zone in a west-facing creek towards the centre of the Survey Area (see Figure 13.3.3).

2.5 The mid-level of the saltmarsh was dominated by SM13 *Puccinellia maritima* saltmarsh community. In some areas, such as north of the Kent Pylon in the west of the Survey Area, the seaward edge of this community formed a sheer face of clay, ca. 1 to 2 m in height. There was generally little or no saltmarsh vegetation below this face (although a little SM6 saltmarsh occurred occasionally).

2.6 The upper saltmarsh was heavily dominated by S24 *Elymus pycnanthus* saltmarsh community. The dominant species, sea couch *Elytrigia atherica* extended onto the sea defence embankment and inland into grassland habitats behind this (although the base of the embankment generally marked the upper extent of saltmarsh habitat). Low areas within the upper marsh supported the SM23 *Spergularia maritima-Puccinellia distans* saltmarsh community.

2.7 An attenuation basin in the west of the Survey Area supported some SM16 Festuca rubra saltmarsh community, and areas of low vegetation dominated by sea plantain.

2.8 The following paragraphs describe these plant communities in more detail

SM6 *Spartina anglica* saltmarsh community

2.9 Vegetation composed almost entirely of common cord grass was present on the seaward edge of parts of the saltmarsh. The largest such areas were in an east-facing bay close to the western limit of the Survey Area (see Figure 13.3.1) and on parts of the eastern edge of the peninsular (see Figure 13.3.1). Smaller patches were present in other parts of the

Survey Area. Very occasionally small stands of this species were present within other saltmarsh communities, but these were generally too small to map separately. Very occasionally, other plant species occurred amongst the common cord-grass, such as sea aster and the bladder wrack *Fucus vesiculosus*. See Photographs 1 and 2.

2.10 Given the lack of floristic variation within SM6 saltmarsh, no sub-communities have been described for SM6 by Rodwell et al. (2000).

2.11 The constancy (and dominance) of common cord-grass clearly indicates that this vegetation is the SM6 saltmarsh community, since no other recognised saltmarsh communities have this as a constant species

2.12 All areas of this community that have been mapped are considered to be low saltmarsh

S21a *Scirpus maritimus* swamp, *Scirpus maritimus*-dominated sub-community

2.13 Vegetation composed almost entirely of sea club-rush was present on some areas of soft mud on the seaward edge of parts of the marsh. This vegetation was present in the west-facing bay mentioned under S6 above (Figure 13.3.1) and is also very abundant on most of the mud banks around the creek and boat moorings towards the centre of the Survey Area (Figure 13.3.3). See Photographs 1, 3, 5 and 7.

2.14 The only recognised plant community in which sea club-rush forms a significant component is the S21 swamp. A number of sub-communities are described for this community, of which S21a is strongly dominated by sea club-rush with few other species (corresponding to the lower marsh community encountered here). S21b contains a wider range of saltmarsh species, such as sea aster and sea arrow-grass, and the other sub-communities contain species characteristic of higher marsh or fully terrestrial habitats.

2.15 MAVIS analysis of the four quadrats taken from the vegetation almost entirely dominated by sea club-rush yields a highest fit to S21a (54.3%). Next highest fits are to S21b (47.62%) and then to the combined dataset for all of the S21 sub-communities (40.3%). All other fit values are below 30.0%.

2.16 Areas of S21b within the Survey Area were all considered to be mid-marsh vegetation, since they were on higher and firmer substrates than S21a or SM6, but below S24 (see below), which is an upper marsh community.

SM13 *Puccinellia maritima* saltmarsh community

2.17 There was a band of vegetation immediately inland of the SM6 saltmarsh and S21a swamp which had abundant sea aster, sea arrowgrass *Triglochin maritimum*, common saltmarsh-grass and sea plantain at the time of the survey. Saltmarsh rush *Juncus gerardii* and red fescue *Festuca rubra* were only occasionally present. Where SM6 saltmarsh and S21a swamp were not present, S13 saltmarsh typically forms the outer edge of the saltmarsh, and a low clay or mud cliff edge formed its lower limit), See Photographs 4, 6 and 7.

2.18 The fact that common saltmarsh-grass was constant, and that saltmarsh rush, red fescue and creeping bent *Agrostis stolonifera* are not frequent, indicates that this vegetation has closest affinity to the SM13 saltmarsh community, rather than the somewhat similar SM16 community. From the quadrat data obtained, there is no obvious match with particular sub-communities of SM13, although the fact that sea-milkwort *Glaux maritima* and sea plantain are constant and small cord-grass *Spartina maritima* was not recorded suggests greatest similarity to the S13b *Glaux maritima* sub-community and S13d *Plantago maritima-Armeria maritima* sub-community (although it is notable that sea thrift *Armeria maritima*, a constant species for S13d, was not recorded).

2.19 MAVIS analysis of the five quadrats taken from this vegetation yields a highest fit to SM13d (60.1%). Next highest fits are to SM16b (59.4%), SM16a (58.0%) and SM13b (56.4%). All other fit values are below 55%.

2.20 Since there is no clear match with a particular sub-community, this vegetation is only specified to community (rather than sub-community level) in this report.

2.21 Areas of S13 within the Survey Area were all considered to be mid-marsh vegetation, since they were on higher and firmer substrates than S21a or SM6, but below S24 (see below), which is an upper marsh community.

SM23 *Spergularia marina-Puccinellia distans* saltmarsh community

2.22 In many parts of the Survey Area, there was a strip just seaward of the sea defence embankment that was slightly lower lying than the adjacent saltmarsh. These strips had bare ground with surrounding vegetation dominated by reflexed saltmarsh-grass *Puccinellia distans*, within frequent annual sea-blite *Suaeda maritima* and occasionally some lesser sea-spurrey *Spergularia marina*, and, in some areas, a few other species such as sea purslane *Atriplex portulacoides* (formerly called *Halimone portulacoides*). See Photographs 8 and 9.

2.23 A similar habitat was present in a small area of upper marsh near the creek at the centre of the Survey Area (Figure 13.3.3); this also has some creeping bent *Agrostis stolonifera* and meadow fescue *Schedonorus pratensis*) and within the channel behind the sea defence embankment at the east of the Survey Area (virtually all of the vegetation here, which supported almost exclusively reflexed saltmarsh-grass, was dead at the time of the survey). See Photograph 10.

2.24 The dominance of reflexed saltmarsh grass, and the presence of lesser sea-spurrey and annual sea-blite indicate that this vegetation has affinity to SM23 saltmarsh. Rodwell et al. (2000) note that this community is associated with hyper-saline pans within the upper marsh and can occur on and behind sea walls. No sub-communities have been described.

2.25 MAVIS analysis of the eight quadrats taken from this vegetation yield a highest fit to SM23 (52.9%). The next highest fit is to S21b (48.9%) and to the combined dataset for all of the S21 sub-communities (46.4%). (However, it is clearly not S21 swamp due to the complete absence of sea club-rush). All other fit values are below 40%.

2.26 All areas of SM23 saltmarsh within the Survey Area are considered to be high marsh.

SM24 *Elymus pycnanthus* saltmarsh community

2.27 The higher sections of saltmarsh within the Survey Area were dominated by sea-couch. Sea purslane was present in many of the quadrats. Other species were relatively infrequent, with sea aster and spear-leaved orache being the most frequent. See Photographs 11, 12 and 13.

2.28 The constancy of sea couch indicates strong affinity to the SM24 community. No sub-communities of SM24 have been described by Rodwell et al. (2000).

2.29 All areas of SM24 saltmarsh within the Survey Area are considered to be high marsh.

S4 Phragmites australis swamp

2.30 Several areas of vegetation that comprised dense stands of common reed were present in proximity to sources of freshwater within the survey area. See Photographs 6 and 14. Other plant species were rare, except on the periphery, where there was some spear-leaved orache, sea club-rush and sea aster.

2.31 Based on the dominance of common reed, this vegetation is clearly S4 swamp. On the basis that this vegetation occurs in association with saltmarsh habitats and has saltmarsh species growing on its periphery, it is has affinity to the S4d *Atriplex prostrata* sub-community, although the stands of pure common reed towards the centre are closer to the S4a *Phragmites australis* sub-community. Because of the difficulty in walking through this vegetation, these sub-communities were not mapped or sampled separately, and this vegetation is only specified to community (rather than sub-community level) in this report.

2.32 Based on its position above SM6 saltmarsh and S21 swamp, at a level equal to SM13 or SM24, the S4 swamp within the Survey Area is considered to be mid or high marsh.

Inland channel at western end of the survey area

2.33 A low-lying narrow basin (ca. 400 m in length) was present at the western end of the Survey Area (this is the stretch of saltmarsh habitat separated from the intertidal zone indicated on Figure 13.3.1). This is situated landward of the sea defence embankment and is not connected to the sea. It is a leachate attenuation basin. From the plant species present, there is likely to be a saline influence here, such as via sea spray in rough weather.

2.34 An area of vegetation dominated by an almost pure stand of common reed was present towards the centre of the basin. This is considered to be S4 swamp, as described previously. Other habitat types are described below:

Sea plantain-dominated lawn

2.35 The basin was vegetated throughout. The dominant habitat was a short lawn dominated by sea plantain, with other saltmarsh species present in some areas, including common

saltmarsh grass, and very occasionally, annual sea-blite and common glasswort *Salicornia europae*a. The grasses red fescue and creeping bent were abundant in some areas. From the low, tight sward and the prostrate growth form of the plants here, this area appeared to be subject to at least occasional management by mowing. See Photograph 15.

2.36 This community does not have close affinity to described saltmarsh (or other) NVC communities, probably because of the unusual combination of setting, management and history.

2.37 MAVIS analysis of the two quadrats taken from this vegetation yield a highest (although low) fits to SM13d (38.2%), SM14c (37.7%), SM12 (37.3%), and SM15 (37.1%).

SM16 Festuca rubra saltmarsh community

2.38 Some deeper areas of the basin had some standing water present at the time of the survey. These supported vegetation dominated by sea rush *Juncus maritimus*, saltmarsh rush *Juncus gerardii*, and sea plantain, with smaller amounts of common reed, sea aster, common saltmarsh grass and reflexed saltmarsh grass. See Photograph 16.

2.39 This mix of species, particularly the presence of red fescue and the abundance saltmarsh rush, suggest that this community has affinity with the SM16 Festuca rubra saltmarsh community.

2.40 MAVIS analysis of the two quadrats taken from this vegetation yield a highest fit to SM16a (72.7%), the *Pucinellia maritima* sub-community of SM16. The next highest fits are to SM16c (64.3%) and SM15 (60.6%). All other fit values are below 60%.

EU ANNEX I HABITATS

2.41 Of the plant communities present in the Survey Area, SM13 saltmarsh and SM23 saltmarsh are EU Annex I habitats (corresponding to 1330 Atlantic salt meadows and 1340 Inland salt meadows respectively) (European Commission, 2013). In addition, 'Estuaries' comprise EU Annex I habitat 1130.

SECTION 41 HABITATS

2.42 'Coastal Saltmarsh' is a Habitat of Principal Importance in England on Section 41 of the NERC Act. For the corresponding UK Biodiversity Action Plan Priority Habitat, it is described as: "the upper, vegetated portions of intertidal mudflats, lying approximately between mean high-water neap tides and mean high water spring tides. For the purposes of this action plan, however, the lower limit of saltmarsh is defined as the lower limit of pioneer saltmarsh vegetation (but excluding seagrass *Zostera* beds) and the upper limit as one metre above the level of highest astronomical tides to take in transitional zones" (BRIG, 2011). This is likely to include all vegetation seaward of the sea defence embankment in the Survey Area.

PHASE 1 SALTMARSH HABITAT

2.43 Based on the JNCC *Handbook for Phase 1 habitat survey* (JNCC, 2010), the Phase 1 habitat 'saltmarsh' includes the following communities that are present in the Survey Area: SM6, SM13, SM16, SM23 and SM24.

2.44 S21 and S4 included under the Phase 1 habitats 'swamp' and 'marginal vegetation'.

CONDITION ASSESSMENT

2.45 The majority of the saltmarsh within the Survey Area is considered to be in 'Fairly good' condition based on Natural England criteria (Natural England, 2020), because 'zonation of vegetation is present but may have gaps or be incomplete' and 'processes appear to be functioning and not compromised by artificial structures' despite the significant presence of the embankment and the abundant wood and plastic rubbish in the shallow bay near the western limit of the Survey Area (Figure 13.3.1). Selected indicators of poor condition are considered in more detail in Appendix 3.0.

2.46 The low lawn of sea plantain in the inland basin in the west of the Survey Area, and the SM23 vegetation heavily dominated by reflexed saltmarsh-grass in the inland channel in the east of the Survey Area are considered to be saltmarsh in 'Poor' condition due to the dominance of single species, adverse management in the first of these two areas and adverse water quality (evidenced by an algal mat) and drought in the second of these two areas.

Golden samphire *Inula crithmoides*

2.47 This plant species is Nationally Scarce, although it is listed as Least Concern in the Vascular Plant Red List for England (Stroh *et al*., 2014)). It was noted as occasionally present on the seaward edge of low clay cliffs that support SM13 and SM24 saltmarsh along the eastern third of the survey area.

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Photographs

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Photograph 1. SM6 low saltmarsh dominated by common cord grass (foreground) with a large area of S21a swamp dominated by sea club-rush (background). This is a shallow sheltered bay towards the western limit of the survey.

Photograph 2. Small areas of SM6 low saltmarsh dominated by common cordgrass (left) quickly grading into SM24 upper marsh dominated by sea couch on a steep shore towards the eastern survey limit.

Photograph 3. Entrance to creek towards centre of Survey Area, showing SM21a in background, and SM13 saltmarsh (with some sea club-rush) in foreground.

Photograph 4. Small patch of SM21b swamp just north of an electricity pylon, with SM13 saltmarsh seaward of this and in foreground.

Photograph 5. SM21b swamp in foreground, and SM21a on low marsh in background. The sea club-rush in the latter area has a much lower stature and is brown in colour.

Photograph 6. Narrow band of SM13 mid saltmarsh (with prominent sea aster) quickly grading into SM24 upper marsh dominated by sea couch. S4 swamp with common reed in background around a stream.

	
Photograph 7. SM13 saltmarsh in foreground with saltmarsh-grass and sea aster, and areas of low marsh S21a swamp with sea club rush (background)	Photograph 8. SM23 saltmarsh with extensive common and reflexed saltmarsh-grass at base of the sea defence embankment.
	
Photograph 9. Open SM23 saltmarsh with reflexed saltmarsh-grass and adjacent sea aster, around bare and dry mud.	Photograph 10. Open SM23 saltmarsh in an inland channel in the east of the Survey Area. Dominated by dead reflexed saltmarsh-grass with a dead algal mat present.
	
Photograph 11. SM24 saltmarsh dominated by sea couch.	Photograph 12 SM24 with abundant sea purslane in addition so sea couch.

Photograph 13. SM24 in the bay near the western limit of the survey showing abundant plastic and wood rubbish.

Photograph 14. Close up of seaward edge of S4 swamp. Saltmarsh species are only present along the outer edge of the dense stand of common reed.

Photograph 15. Lawn dominated by sea plantain at the western end of the attenuation basin in west of of the Survey Area.

Photograph 16. Rush-dominated vegetation in centre of attenuation basin at west of Survey Area. Has affinity to SM16 dute to abundance of saltmarsh rush.

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Appendices

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Appendix 1.0 Figures

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Figure 13.3.1: National Vegetation Classification map

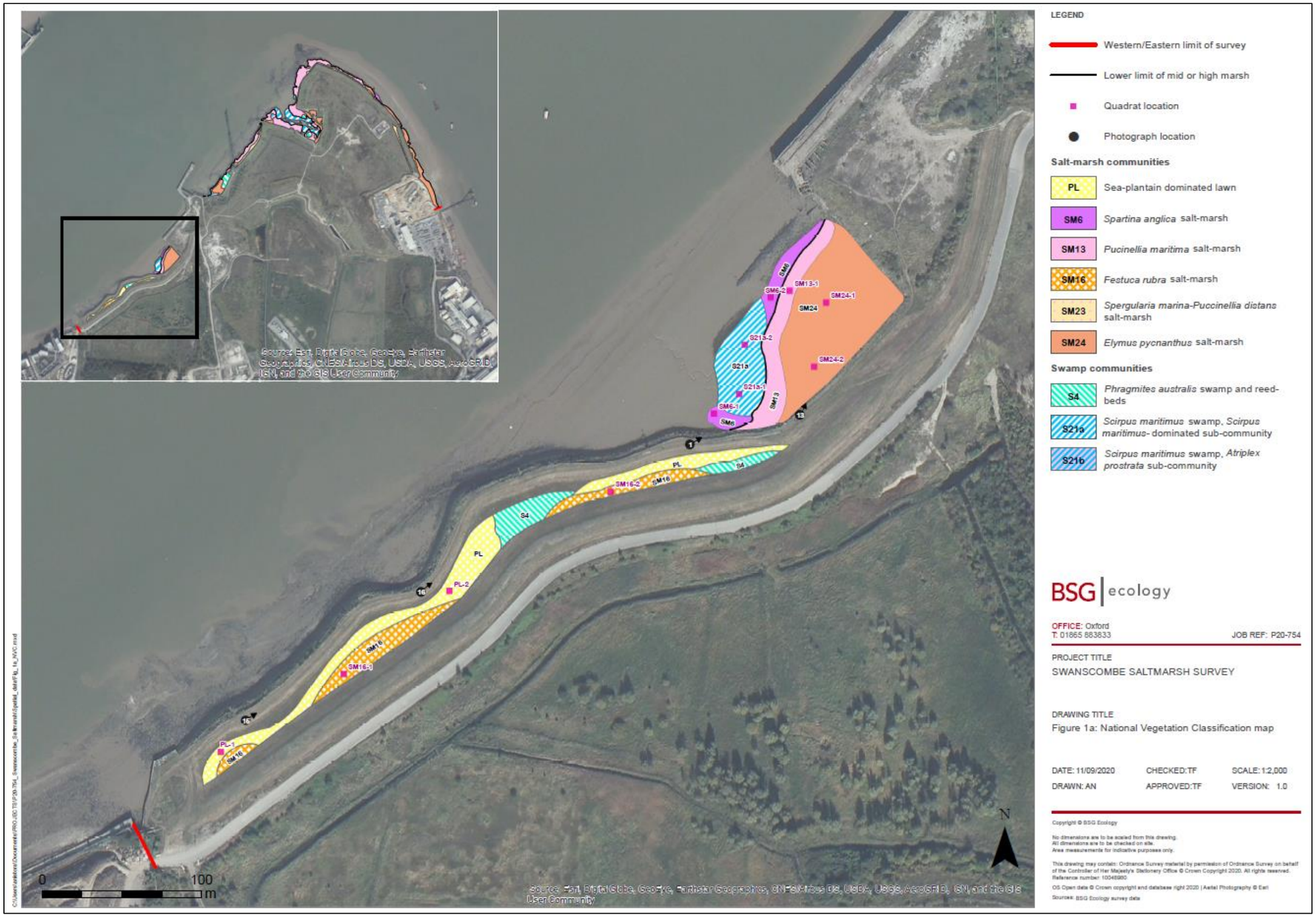

Figure 13.3.2: National Vegetation Classification map.

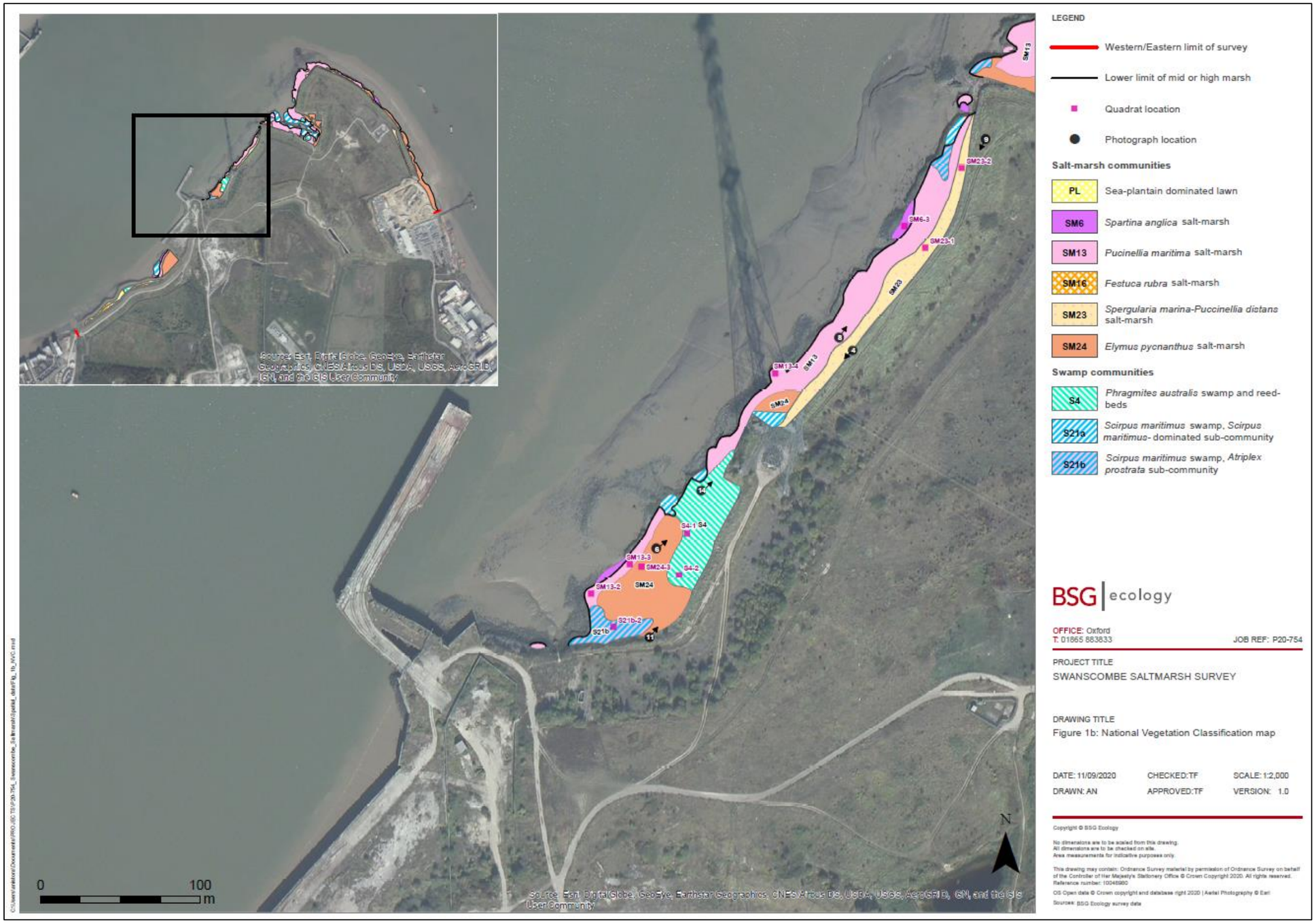

Figure 13.3.3: National Vegetation Classification map.

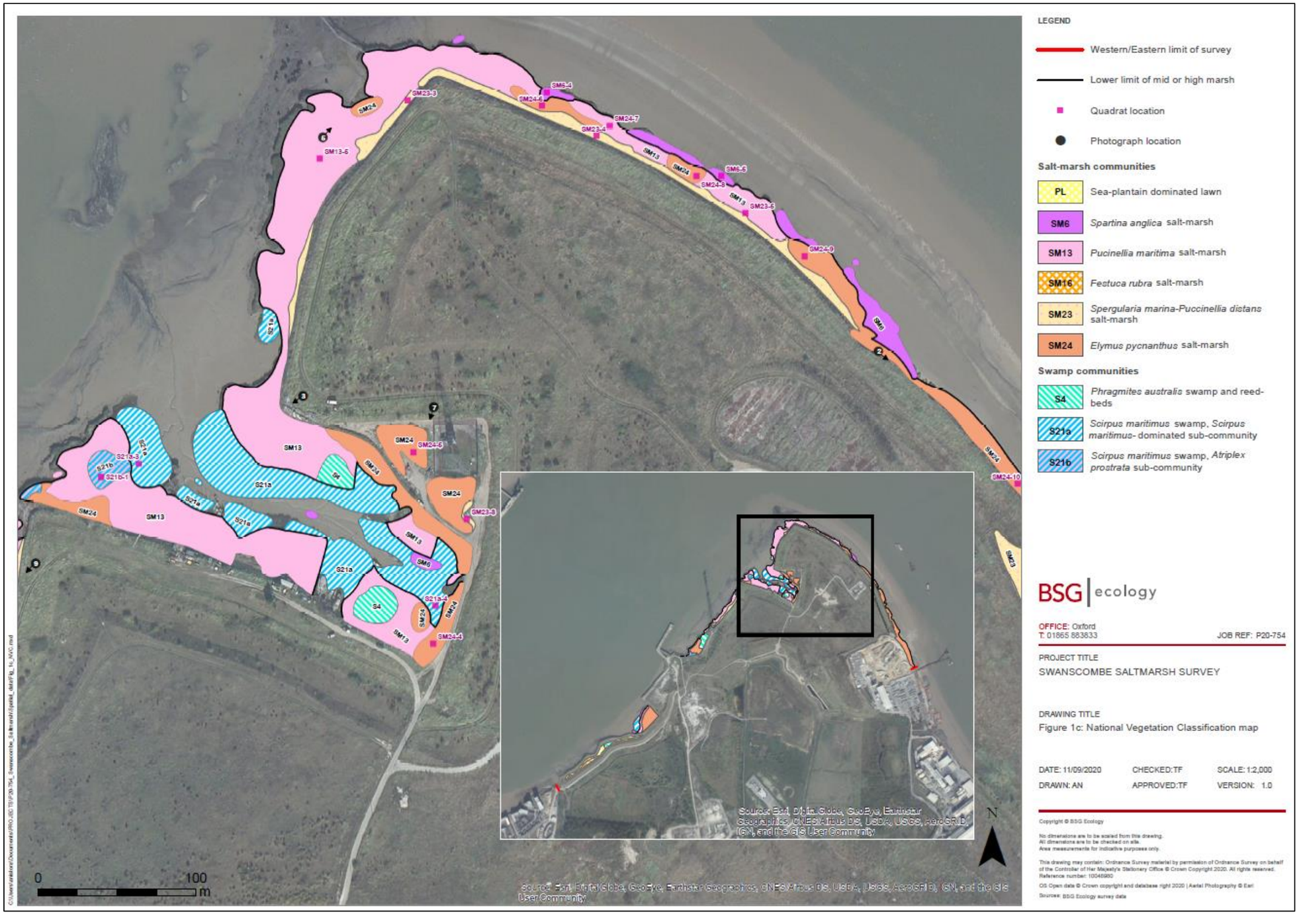

Figure 13.3.4: National Vegetation Classification map.

Appendix 2.0 Botanical Data

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Table 1-1: Botanical Data for SM6

Scientific name	Common name	Quadrat number					Frequency class (and % cover range)
		SM6-1	SM6-2	SM6-3	SM6-4	SM6-5	
Spartina anglica	Common cord-grass	100	100	80	100	70	V (70–100)
Fucus vesiculous	Bladder wrack			5		2	II (2–5)
Aster tripolium	Sea aster					2	I (1–2)

Table 1-2:Botanical Data for S21a

Scientific name	Common name	Quadrat number				Frequency class (and % cover range)
		S21a-1	S21a-2	S21a-3	S21a-4	
Bulboschoenus maritimus	Sea club-rush	85	80	80	90	V (80–90)
Aster tripolium	Sea aster	2	2		2	III (2–2)
Spartina anglica	Common cord-grass	4				II (4–4)

Table 1-3: Botanical Data for S21b.

Scientific name	Common name	Quadrat numbers		Frequency class (and % cover range)
		S21b-1	S21b-2	
Bulboschoenus maritimus	Sea club-rush	30	60	V (30-60)
Aster tripolium	Sea aster	20	5	V (5–20)
Puccinellia maritima	Common saltmarsh-grass	20	5	V (5–20)
Aster tripolium	Sea aster	20		III (20–20)
Elytrigia atherica	Sea couch		10	III (10–10)
Atriplex prostrata	Spear-leaved orache	2		III (2–2)

Table 1-4: Botanical Data for SM13.

Scientific name	Common name	Quadrat numbers					Frequency class (and % cover range)
		SM13-1	SM13-2	SM13-3	SM13-4	SM13-5	
Aster tripolium	Sea aster	15	20	5	20	20	V (5–40)
Puccinellia maritima	Common saltmarsh-grass		20	40		60	IV (20–70)
Triglochin maritimum	Sea arrow-grass	50	30		10	5	IV (5–50)
Plantago maritima	Sea plantain	4	5		20	10	IV (4–20)
Atriplex prostrata	Spear-leaved orache	2		5		5	IV (2–5)
Glaux maritima	Sea-milkwort	2	5		4	5	IV (2–5)
Juncus gerardii	Saltmarsh rush			10			I (20–20)
Spartina anglica	Common cord-grass			10			I (10–10)
Spergularia media	Greater sea-spurrey				2		I (2–2)

Table 1-5: Botanical Data for SM23

Scientific name	Common name	SM23-1	SM23-2	SM23-3	SM23-4	SM23-5	SM23-6	SM23-7	SM23-8	Frequency class (and % cover range)
Puccinellia distans	Reflexed saltmarsh-grass	70	90	100	60	80	70	60		V (60–100)
Suadea maritima	Annual sea-blite	5	2		15	10	10			IV (2–15)
Atriplex protsrata	Spear-leaved orache	2	2			2			5	III (2–2)
Pucinella maritima	Common saltmarsh-grass						10	20		II (10–20)
Elytrigia atherica	Sea couch						10		5	II (5–10)
Spergularia marina	Lesser sea-spurrey	2							10	II (2–10)
Aster tripolium	Sea aster			2		2				II (2–2)
Agrostis stolonifera	Creeping bent								10	I (10–10)
Atriplex protulacoides	Sea-purslane				5					I (5–5)
Schedonorus pratensis	Meadow fescue								5	I (5–5)

Table 1-6: Botanical Data for SM24

Scientific name	Common name	Quadrat numbers										Frequency class (and % cover range)
		SM24-1	SM24-2	SM24-3	SM24-4	SM24-5	SM24-6	SM24-7	SM24-8	SM24-9	SM24-10	
Elytrigia atherica	Sea couch	30	30	90	100	80	10	15	10	10		V (10–100)
Atriplex portulacoides	Sea-purslane	15	25				90	70	90	100	90	IV (15–100)
Atriplex protsrata	Spear-leaved orache	2		5	2			1				II (1–5)
Aster tripolium	Sea aster	20	35									I (20–35)
Agrostis stolonifera	Creeping bent					20						I (20–20)
Plantago maritima	Sea plantain	5										I (5–5)
Suadea maritima	Annual sea-blite										5	I (5–5)
Limonium vulgare	Common sea lavender	2										I (2–2)
Senecio jacobaea	Ragwort					1						I (1–1)
Spergularia media	Greater sea-spurrey										1	I (1–1)

Table 1-7: Botanical Data for S4

Scientific name	Common name	Quadrat numbers		Frequency class (and % cover range)
		S4-1	S4-2	
Phragmites australis	Common reed	100	100	V(100-100)

Table 1-8: Botanical Data for sea-plantain dominated lawn.

Scientific name	Common name	Quadrat numbers		Frequency class (and % cover range)
		PL-1	PL-2	
Plantago maritima	Sea plantain	50	80	V (50–80)
Phragmites australis	Common reed	2		III (2–2)
Aster tripolium	Sea aster	2		III (2–2)
Salicornia europaea	Common glasswort	4		III (4–4)
Puccinellia maritima	Common saltmarsh-grass		5	III (5–5)

Table 1-9: Botanical Data for SM16.

Scientific name	Common name	Quadrat numbers		Frequency class (and % cover range)
		SM24-1	SM24-2	
Plantago maritima	Sea plantain	30	20	V (20–30)
Juncus gerardii	Saltmarsh rush	20	20	V (20–20)
Puccinellia maritima	Common saltmarsh-grass	10	15	V (10–15)
Triglochin maritimum	Sea arrowgrass	10	10	V (10–10)
Aster tripolium	Sea aster	2	5	V (2–5)
Juncus maritimus	Sea rush	30		III (30–30)
Agrostis stolonifera	Common bent	10		III (10–10)
Festuca rubra	Red fescue		5	III (5–5)
Phragmites australis	Common reed	5		III (5–5)

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Appendix 3.0 Condition Assessment criteria

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Table 1-10: Indicators of poor condition (from Natural England, 2020).

Criterion	Observation
Is there algal growth present that could be an indication of water pollution or enrichment?	Only noted in the channel behind the sea defence embankment at the east of the Survey Area
How much algal growth is present that would indicate water pollution or enrichment (low, moderate, high)? Descriptive response needed, no definition for low, med, high available	Algal mat is abundant at the above location. Not present elsewhere.
Are there any direct effluent discharges?	None were seen during the survey.
Are there non-native species present?	Yes
How many non-native species are present (plant and animal), number of species and number of individuals, where countable?	Only common cord-grass *Spartina anglica* was noted.
What percentage of the area is occupied by non-native species plants?	<1%
Is the tidal inundation regime affected by structures or actions? If so how much is the functionality affected?	The sea defence embankment had compressed the intertidal zone significantly.
Is the zonation of the vegetation present?	Yes
Is zonation of vegetation continuous, has gaps/is incomplete, or patchy?	Across the site as a whole, low, mid and upper marsh are present. This is also the case in many individual areas. Low marsh is missing in some areas, thought be due to the steep intertidal on the eastern side of the peninsular, possibly resulting from the embankment, or simply the strong tidal flow in the estuary.
Does the vegetation have a mixed structure reflecting variation in species composition?	Yes
Are there algal mats present in water column or on saltmarsh vegetation at low tide?	No